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GEOLOGY.—*On the geological age of the Walker Hotel swamp deposit, in Washington, D. C., and on the origin and the ages of the Coastal Plain terraces in general.* OLIVER P. HAY, CARNEGIE INSTITUTION OF WASHINGTON. (Communicated by G. P. MERRILL.)

The first number of the current volume of the JOURNAL contains four articles which describe a swamp deposit that is found in the city of Washington and is regarded as buried in the Wicomico terrace. The present writer will not delay to describe in any way this deposit and its fossil contents. This work was done by the authors of the papers in a manner worthy of the highest praise. Only with certain opinions assumed or expressed by some of the authors regarding the age of the Wicomico terrace and of the manner of its formation does the present writer take issue. The theory entertained by the authors of the papers referred to is essentially the one proposed by McGee and supported especially by Shattuck and other geologists of the Maryland Geological Survey. It is to the effect that for each terrace there was a submergence of the coast beneath the sea during which deposits were laid down along the new strand and distributed by the waves of the sea and its estuaries. According to McGee and Shattuck, the submergences affected the coast from about Staten Island to Florida and even to the Rio Grande; but the authors of the papers on the Walker Hotel deposit do not commit themselves on this point.

The present writer believes that it is unnecessary to suppose that the terraces along the coastal plain and its estuaries were built up by the sea. Terraces are found along nearly all of our great rivers. Furthermore, some of our ablest geologists believe that the coastal plain terraces are wholly, or almost wholly, the product of river action. I occupy no original position in the matter.

To the writer, the most convincing argument against the theory that the terraces were built up at sea level or below it, is found in the total lack of marine and estuarine fossils in them, except in some deposits near the present sea level.

In the Pleistocene volume of the Maryland Geological Survey this sentence is found: "The lack of abundance of fossils seems in a large measure to be due to unfavorable conditions for preserving the hard parts of animals which probably inhabited the estuaries and open water of the ocean in large numbers" (p. 102).

What are the probabilities that there was an abundance of marine animals living along the Atlantic and Gulf coasts during each of the submergences? Besides the forms of life which inhabit deep water, there are numerous species of fishes, mollusks, crustaceans, echinoderms, tunicates, and worms which live between tides or in comparatively shallow water. When, according to McGee's theory, as developed in his monograph,[1] illustrated by his maps, and accepted in principle by various geologists, the land from the Rio Grande north to Long Island or farther was depressed 500 feet, all the shallow water forms were compelled to move to the new strand or perish. The species occupying deeper waters undoubtedly would likewise migrate in the same direction. Inasmuch as all but a few per cent of the fauna that lived during the late Pliocene still lives, it is evident that all those marine animals inhabited the strand a hundred or two hundred miles from the present shore of the Atlantic and Gulf States and north to southern Illinois in the Mississippi embayment. Who can doubt then, that in that Lafayette marine terrace and its extension oceanward, if there was such a terrace, there were buried in abundance the remains of mollusks and fishes, besides the bones of roving cetaceans and turtles? When the coastal plain rose and the Lafayette sea was pushed back, the marine creatures retired with it; and we find that not long afterward their descendants left their remains in the early Pleistocene beds all along the present coast line. When, according to the same theory, the Sunderland depression of the land occurred, those marine tribes migrated to the Sunderland level and left their shells and skeletons in the sands and clays of that terrace. Can we doubt that somewhere during that time there were piled up beds of oyster shells such as were at some time laid down at Wailles Bluff, or strata of molluscan shells such as are to be found in the Pleistocene in Florida? A similar migration and return of

[1] U. S. Geol. Survey, Twelfth Annual Report, Part 1.

marine forms must be assumed to have occurred when the Wicomico terrace was laid down, and again the same changes of habitat and the same burial of fossilizable remains during the formation of the Talbot terrace.

We must consider the immense extent of time during which those terraces were submerged. If we allow 500,000 or 1,000,000 years in round numbers for the Pleistocene and then some thousands or hundreds of thousands of years for the Lafayette, it is evident that the construction of each terrace occupied a long period of time; and during this there was being entombed an abundance of fossil shells and bones, whatever may have become of them afterward. But, excepting again some of the deposits found now within a few feet of sea-level, not a scrap of all these creatures has ever been found in those terraces. That is admitted by the adherents of the theory. The explanation of this remarkable fact is that put forth in Professor Shattuck's sentence already quoted; that is, that the conditions for preservation have been unfavorable. That may be a sufficient explanation, but we should ask whether the conditions were unfavorable.

We must have in mind a coastal plain 2000 miles or more long and averaging probably more than 100 miles wide. During probably 500,000 or 1,000,000 years, parts of it were alternately dry land and sea-bottom. This plain was subjected to the influences of 4 or 5 glacial and a corresponding number of interglacial stages. During each of these stages the climate and the deposits at any locality depended partly on its position within 16 degrees of latitude and 25 degrees of longitude. Coarse sediments were poured into the sea by rivers rising in near-by glaciers or in more or less distant mountains. From other rivers, as the Mississippi and the great rivers of Texas, mud and fine sands were laid down. It is hard to believe that nowhere in approximately 200,000 square miles were mollusks buried under conditions that insured their preservation. At the end of the Wisconsin stage the sea entered Canada and Lake Champlain and in a small part of one glacial stage, laid down a formation which contains numerous molluscan shells, and the bones of whales, porpoises, and seals. If it be said that there has not been time for the dissolving of these shells, attention may be called to the beds of mollusks found from Dismal Swamp to southern Florida, which have resisted destructive agencies since the early Pleistocene.

There are, however, an abundance of fossils on all of those terraces from Staten Island to the Rio Grande, but these are not of marine, but of land animals, consisting of the bones and teeth of ground-

sloths, horses, tapirs, camels, deer, bisons, elephants, mastodons, and numerous other vertebrates.

It may be true that under the same conditions the shells of mollusks are more likely to be dissolved by the action of percolating rain-water than are the bones and teeth of land vertebrates. Nevertheless, the latter are more exposed to destruction than are marine mollusks. The skeleton of a land animal is usually exposed on the surface where decay is rapid. Only those skeletons which are soon covered up by water and earth are likely to be preserved, and of these only a few. It is probable that not one elephant in a million left any trace of itself, whereas of a bed of oysters, every shell may be preserved. The first process in the fossilization of a bone is the decay of the animal matter, leaving the mass porous and permeable to water. It may remain porous and little mineralized for thousands of years, unless dissolved. The molluscan shell is much more solid, is rarely exposed to the air, and is soon buried in mud.

But if the sea prevailed over the coastal plain terraces for thousands of years it is not mollusks alone that were buried there. There are marine as well as terrestrial vertebrates. In those seas were numerous fishes, large and small; there were porpoises and whales, and various species of vagrant turtles. The bones of all these would have been buried in the Lafayette, the Sunderland, the Wicomico terraces, as well as in the Talbot. Great and little sharks would have left their teeth in the deposits. The bones of a fish, of a porpoise, of a whale, or of a sea turtle, remaining in the water and soon covered up in mud, are far more likely to become fossilized than the bones of a land animal. The mass of fish bones produced on a coast must quite equal the mass of molluscan shells. While the sea was occupying successively the Lafayette, the Sunderland, and the Wicomico terraces, what had become of the Florida sea-cow, or manatee? Its large solid and heavy bones would certainly have been left somewhere on those terraces, possibly everywhere from the present coast to Montgomery, Alabama, and Vicksburg, Mississippi. Nevertheless, no bones of any marine fish, no teeth of sharks, no bones of porpoises, or of whales, none of sea turtles, or of the sea-cow, have ever been discovered in the Lafayette terrace, the Sunderland, or the Wicomico. It seems to me, therefore, that no shells and no bones of marine vertebrates are found there simply because they were never buried there.

How, then, were those terraces formed? It is the business of geologists to solve the problem; but in reaching their conclusions they must not ignore paleontology, not even vertebrate paleontology.

Before venturing any suggestions as to the manner of development of the terraces of the coastal plain, a consideration must be given to their age. The writer believes that all the terraces, except perhaps the Lafayette, are far older than has been supposed; and, to come to the point at once, he believes that the Talbot plain is of early Pleistocene age, probably of about the first interglacial state. This need not be taken to mean that no deposits whatever were laid down on it during later stages. The Wicomico and the Sunderland are of course still older. My reasons for believing that the Talbot is so old is that it contains, all along the coast from Staten Island to Mexico, what I regard as a first interglacial vertebrate fauna. This fauna is widely distributed over the peninsula of Florida and along the coast of Texas. In Florida it is best revealed at Vero, on the eastern coast at about the same latitude as Tampa Bay.

The lowest terrace in Florida recognized by Matson and Sanford[2] is the Pensacola, which rises from sea-level to about 40 feet. This elevation corresponds accurately with that of the Talbot of Maryland.[3] 'At the fossil-bearing locality near Vero, the surface is approximately 10 feet above sea-level. The bed which contains the oldest fauna is about 2 feet thick and is underlain by a stratum filled with Pleistocene mollusks and overlain by a bed of muck about 3 feet thick. The fossils are, therefore, near the surface. The most important species are a tiger, a saber-tooth tiger, a dog closely akin to one found at La Brea, California, a camel, two tapirs, three horses, a giant armadillo, two ground-sloths, and various tortoises. On the same plain, three miles distant and on the same geological level, *Elephas imperator* was found. Of the 29 species, 21 are extinct; that is, 72 per cent. The fauna is practically that of the so-called Hay Springs locality, on Niobrara River, Nebraska, and that of the Aftonian of western Iowa, the first interglacial. Unless some one is prepared to dispute the age of those fossils, we may ask what they are doing on that supposed late Pleistocene terrace? If they were buried at considerable depth it might be supposed that the deposit was laid down by a stream before the Sunderland stage and overlain by the seaward deposits of this and the succeeding terrace stages. Who can suppose, however, that the seaward deposits of the Sunderland, the Wicomico, and the Talbot, or their equivalents, would amount to only 2 or 3 feet of sand? Besides this, most of the deposit

[2] Florida Geol. Survey, Second Annual Report, 1913.
[3] Maryland Geol. Survey, Pliocene and Pleistocene, pl. 26.

overlying the fossils mentioned is another stream-laid bed of sand, marl and muck full of the remains of a later land and fresh water fauna. It is evident that ever since early Pleistocene time there has been at that fossil locality a little stream which has not been disturbed by the three supposed submergences of the land and by perhaps as many uplifts of it above its present level and the consequent quickening of the stream which would have scoured those fossils out of their bed.

Farther north, in the vicinity of Brunswick, Georgia, a considerable number of fossil vertebrates has been found. In a canal made through a swamp, at a depth of 4 to 6 feet, there were found remains of the gigantic ground-sloth, *Megatherium*, elephant, horse, and bison. Beneath the clay bearing these fossils there was a bed containing sea shells. The relative position of the two beds appears to be the same here as it is at Vero, Florida. The same megatherium, a mylodon, three species of horses, a tapir, and other vertebrates were later dredged up in the harbor at Brunswick. The vertebrate-bearing stratum at this place has apparently been undermined by the river, as at Charleston. Farther north, at Savannah, on Skidaway Island within 3 or 4 feet of the surface and near sea-level, there have been found 7 species of vertebrates, all extinct, among them the two ground-sloths, *megatherium* and *mylodon*, and *Equus*. The bones present no indications of having been transported and redeposited.

The region about Charleston is rich in Pleistocene fossils. I have a record of 36 species, including mammals, of which 80 per cent are extinct. The bone-bearing bed is only a few feet above tide. While some species occur in place in this bed, most of those collected have been secured in dredging for phosphate rock and are mixed with species of Tertiary age. How this mixture has occurred does not matter, for there can hardly be a doubt that the Pleistocene fossils are all of the same age and have been derived from the one stratum. The species of most interest to us found at Charleston are an extinct genus of bear, two species of capybaras, *Elephas imperator*, a very large species of extinct bison, a camel, two species of peccary, three species of horses, the megatherium, and a mylodon. There appears to be every reason for regarding the fauna as equivalent to that found at Vero, Florida, and as belonging to the first interglacial stage. Here, as at Vero, it is on the equivalent of the Talbot terrace and at levels from a little below tide to 15 feet above it.

A few of the bones and teeth found in what appears to have been the original place of burial are somewhat water-worn; but usually

they are finely preserved. In the same stratum there may be an occasional marine vertebrate or mollusk. In a marshy locality at nearly sea-level, inhabited by many species of vertebrates and liable to inundations more or less prolonged, such commingling of species is not unnatural. There is no reason for supposing that there has been redeposition from an older to a more recent bed, excepting of course those fossils mingled with the phosphate.

Along the coast of North Carolina remains of Pleistocene mammals are not so abundant as farther south. Those discovered have been mostly elephants, mastodons, and horses. While these, so far as we know them, might have lived at a somewhat later time than the Aftonian, there is no necessity for supposing that they did. In a canal made through a swamp in Carteret County in a stratum of sand at a depth of 16 feet, elephant and mastodon bones were mingled with sea-shells. In this case, however, the mixture of bones, teeth and shells was probably produced by the excavating machinery. In a marl bed 16 miles below Newbern, besides various other species, were found remains of elephants, mastodons, and horses and other vertebrates mingled with sea-shells. The fossiliferous stratum nowhere rose more than 10 feet above the river. Whether the mollusks found here belong to the Pliocene or to the Pleistocene has been a subject of dispute. If not Pliocene, they are probably early Pleistocene and wherever the bones came from, they too must be of the same or earlier age. The deposit overlying the fossiliferous bed appears to have contained no fossils to show that it was of marine origin.

Along the coast of Virginia few fossils have been found that have a bearing one way or another on the age of the terraces. At Marshall Hall, on the Maryland side of the Potomac, there was found long ago a tooth of an extinct horse; at Georgetown, during the construction of the canal, other horse teeth were discovered. Inasmuch as no horses are known to have survived elsewhere as late as the beginning of the last drift stage, those teeth and the deposit containing them are put back at least into the last interglacial stage. There appears to be no reason why they are not as old as the first interglacial. At Chesapeake Beach in the low-lying deposits, the remains of bison, peccary, and horse have been found. All these appear to have been derived from the Talbot.

Some important discoveries have been made in New Jersey. Just above Camden on the Delaware, there occurs a bed of blackish clay from 20 to 25 feet thick overlain by 8 to 15 feet of sand. Long ago,

near the bottom of the clay and only about 10 feet above high tide, was found the skull of a horse. About 1896, other horse remains were found. Immediately below the level of the horse, there is a deposit containing numerous fresh water clams of the genera *Unio* and *Anodonta*. Salisbury and Knapp regard the clay bed and the underlying and overlying deposits as Pensauken, an extra-morainal deposit which appears to have been laid down about the time of the Aftonian or Kansan stages. The Maryland geologists regard it as belonging to the Cape May, equivalent to the Talbot. A few plants studied by Dr. E. W. Berry of the Maryland Survey caused him to conclude that the probability was strong that the beds were post-glacial in age.[4] It is remarkable that this species of horse, if of post-lacial age, had not pushed its way north to the fine pasture lands formed by the Wisconsin drift in New York, northern Ohio and westward. Furthermore, it is certain that the sea did not occupy that locality when the horses and the freshwater clams were living there. Nor is it probable that the 20 feet of blue clay was laid down in sea-water. As for the overlying sand, marine mollusks have never been reported from it. Even if those sands are of late Pleistocene age there is no sufficient evidence that they were deposited in water below sea-level.

For the following reasons the writer believes that the Fish House clays belong to the first interglacial, or Aftonian stage: 1. Our knowledge of the glacial and interglacial stages, of their relationships, characteristics, and distribution, rest on a more certain basis than does our knowledge of the terraces of the coastal plain. 2. On tracing the terraces to their contact with the glacial and interglacial deposits in New Jersey, it has been found impossible to correlate the two systems. 3. Competent geologists have identified the Fish House beds as early Pleistocene. 4. The conclusion that the Fish House beds belong to the first, or Aftonian, interglacial stage, is in harmony with our determinations of the age of the lowest terrace further south.

At Long Branch, New Jersey, a good many years ago, there was found a heel bone of the gigantic ground-sloth *Megatherium*. This animal has been already mentioned as occurring frequently in the southern States in deposits believed to belong to the early Pleistocene. While it would be impossible at present to prove that this animal did not live during the late Pleistocene, it is improbable that it did so. It may be supposed that there is present along that coast, not

[4] Torreya **10**: 262. 1910.

far below the surface, a stratum of Aftonian age which is being attacked by the sea. If it be affirmed that this Aftonian stratum is overlain by Cape May deposits, attention may be called to the fact that mastodon skeletons buried in peat have been exhumed near Long Branch. The most important of these was discovered 3 miles southwest of Long Branch and 2 miles from the coast. The locality must have been near the town of West Long Branch. The animal was buried in a deposit of black earth, evidently muck, 8 feet thick. The elevation is probably somewhat less than 50 feet. Two sections recorded by Salisbury and Knapp[5] show that the Cretaceous is within about 6 feet of the surface near West Long Branch. To this must be referred the marl mentioned by DeKay.[6] It is probable that the deposit belongs to the Cape May stage, but the muck and the mastodons do not testify strongly to marine occupation.

We ought now to consider briefly the origin of the broad trenches which are now occupied by the lower Potomac and by Chesapeake Bay, the estuary of the Susquehanna. These trenches, many miles wide and of great depth, if one measures from the Sunderland terrace to their ancient bottoms, now buried far beneath later accumulations, have at some time or times been excavated by river action. Occupancy by the sea would contribute to refilling the channels. These troughs must have been scoured out by rivers of immense volume and rapidity of flow. That they might accomplish this work of excavation, even their lower courses must have had some slope, and their sources must have been in elevated regions. Late in the Pliocene and in the early Pleistocene there was a period of uplift which seems to have affected the whole continent and determined the excavation of canyons, gorges, and wide and deep valleys. It was probably during this time of elevation that the estuaries and the terraced slopes of the now drowned lower portions of the Susquehanna and of the Potomac were carved out. The formation of terraces during such work as this would be a natural result. The excavation of the beds of these estuaries and the fashioning of the terraces was accomplished by the end of the first interglacial stage and since that time little change of level apparently has occurred.

Farther south, other rivers coming down from the mountains brought abundant clay, sand, gravel, and boulders to the coastal plain. Here, where the velocity of the streams was reduced, the

[5] New Jersey Geol. Survey 8: 200. 1916.
[6] Ann. N. Y. Lyc. Nat. Hist. 1: 143. 1824.

coarse materials would be dropped in fans; but at length the channels would be blocked and obliged to find new outlets at the sides, continually widening the fans. Fans of neighboring rivers would coalesce and make a continuous terrace-like plain. After perhaps another elevation of the mountains the streams would be quickened and another plain or terrace nearer the sea would be produced. On the southern part also of the coastal plain the terraces were essentially finished before the end of the first interglacial stage and the lowest one was ready to receive and preserve the bones and teeth of the animals which lived. Doubtless all of the terraces were afterward subjected to erosion and all received here and there some additions of material to their surfaces.

Unless, therefore, the writer is greatly in error regarding the history of the Pleistocene and its vertebrate life, the deposit and the fossils found in the Walker Hotel excavation are not only older than the Wisconsin drift and the Illinoian drift, but older than the close of the Aftonian. They may possibly be referred to about the beginning of the Aftonian.

In the Pliocene and Pleistocene volume of the Maryland Geological Survey, (pp. 96–100) Shattuck recorded a number of localities in Maryland where fossils which he refers to the Talbot have been found. Conspicuous among these are the remains of cypress trees. It seems to the writer that it is very probable that these vegetable remains are as old as those found in Washington. In several cases they are buried in a clay deposit which is overlain by sands and gravels which may have been laid down long afterward. At Bodkin Point the presence of casts of Unio shells shows that the water was not salt or brackish. At another locality (p. 99) a deposit of clay carries lignite and *Gnathodon* (*Rangia*) *cuneatus*, a shell now found not farther north than the Gulf of Mexico. At Wailles Bluff a considerable molluscan fauna has been collected. Is it not possible that this deposit is a continuation northward of the shell bed which further south underlies the Aftonian vertebrates and which the writer[1] has referred to the Nebraskan?

[1] Carnegie Inst. Wash. Publication 322, p. 15.

BOTANY.—*Identification of the commonly cultivated species of* Cucurbita *by means of seed characters.* PAUL RUSSELL, Bureau of Plant Industry. (Communicated by WILSON POPENOE.)

The genus *Cucurbita*[1] consists of ten species, all of which are possibly native to the New World, although authorities differ on this point. Seven of these species are perennial, and not cultivated in the United States, while the other three are annual. These are: *C. maxima* Duchesne, of which the Hubbard squash, the Delicious squash, and the Boston Marrow squash are examples; *C. pepo* L., of which the Large Yellow pumpkin, the Pie pumpkin, and the Summer Crookneck squash are examples; and *C. moschata* Duchesne, of which the Sweet Cheese (or Kentucky Field) pumpkin, the Japanese Pie pumpkin, and the Golden Cushaw pumpkin are examples. Besides these, many more varieties are cultivated in the United States. Among these the great diversity of size, shape, color, and character of flesh has made it difficult to determine to which species a given variety may belong.

In order to clear up this confusion, an attempt has been made to devise a key whereby the specific identity of any variety may be determined by means of the external characters of the seeds.

Some writers have included general notes on the seeds in the descriptions of these species, and one of them, C. D. Harz, gives[2] rather full descriptions of the seeds. None of them, however, has given sufficient data to permit a ready differentiation by means of seeds alone. The only mention of a seed scar is by Harz, who states (p. 813) that the seed of *C. pepo* has an oblique scar. Our experiments have shown that this is not the case, for the scar in this species is normally squarely truncate or rounded. (See Fig. 1.)

The work has been much simplified because of the fact, shown by Charles Naudin,[3] L. H. Bailey,[4] and J. P. Lotsy,[5] that these three species do not hybridize, although the varieties, within the species, often cross freely.

The field tests were carried on at the Arlington Experimental Farm, near Washington, D. C., in coöperation with the Department

[1] According to some authorities the use of the name "Cucurbita" should be confined to the species now generally known as *Lagenaria vulgaris* Ser., but since the purpose of this paper does not include a revision of the genus *Cucurbita*, the current usage is followed.

[2] Harz, C. D. Landwirtschaftliche Samenkunde. Berlin. 1885.

[3] Ann. Sci. Nat. Paris. Sec. Bot. **6**: 59. 1856.

[4] Third Ann. Rept. Cornell, N. Y., Exp. Sta. 1890: 180–187.

[5] Genetica **1**: 1–21. 1919.

of Agriculture. The following varieties were grown in 1922 and 1923. The species under which each is listed was determined by botanical characters other than those of the seeds, and the seeds of each group were subsequently studied for specific characters.

Cucurbita maxima: Arikara squash, Banana squash, Boer pumpkin, Boston Marrow squash, Delicious squash, Hubbard squash, Ironbark pumpkin, and Kitchenette Hubbard squash.

Cucurbita pepo: Cocozelle squash, Early Mandan squash, Large Yellow pumpkin, Mammoth Tours pumpkin, Pie pumpkin, and Summer Crookneck squash.

Cucurbita moschata: Charles Naudin squash, Chirimen squash, Courge bedouine, Faan Kwa squash, Golden Cushaw pumpkin, Japanese Pie pumpkin, Macleay River pumpkin, and Sweet Cheese (or Kentucky Field) pumpkin.

KEY TO THE ANNUAL SPECIES OF CUCURBITA

Fruiting peduncle finely ridged, not ribbed; leaves entire or but faintly lobed..... *C. maxima.*
Fruiting peduncle strongly ribbed; leaves distinctly lobed.
Apex of fruiting peduncle not enlarged, or but slightly so; calyx lobes narrow..... *C. pepo.*
Apex of fruiting peduncle much enlarged; calyx lobes usually broad, sometimes leaflike..... *C. moschata.*

Cucurbita maxima was originally described[8] by Duchesne as follows:

Melopepo fructu maximo albo. Tournef. 106.
Cucurbita aspera, folio non fisso, fructu maximo albo sessili. J. B. 2. p. 221.
Pepo maximus indicus compressus. Lob. Ic. 641.
Pepo compressus major. Bauh. Pin. 311.
Cucurbita pepo. a. Linn. ?

The body of the description, which is in French, may be translated as follows:

The large-fruited pumpkin or gourd, *Cucurbi'a maxima* Duch.—This is very different from the other gourds; it is distinguished by the flowers being more widened or enlarged at the base of the calyx, with a reflexed limb, and by the large, rounded-heart-shaped leaves, borne on their petioles in an almost horizontal position. They are softer and their hairs less stiff than in the other gourds, somewhat resembling the leaves of melons. All parts of the plant are stouter and larger than those of the other gourds; the fruit, generally larger and more constant in its flattened-spherical form, has regular ribs and a considerable depression at each end; the pulp is firmer and at the same time juicy and melting; the skin is fine, like that of the Pâtissons. These are the chief characters of this species.

[8] Lamarck Encycl. 2: 151. 1786.

In amplifying the above, it may be said that the leaves of *C. maxima* are more or less kidney-shaped, faintly 5-lobed or altogether entire, never deeply lobed as in the other two species. The fruiting peduncle is cylindrical and finely ridged, never ribbed. The sepals are usually filiform, and the corolla lobes reflexed.

The original description[7] of *C. pepo* L., with its synonymy, is as follows:

Cucurbita foliis lobatis, pomis laevibus.
Cucurbita seminum margine tumido. Hort. Cliff. 452. Hort. Upsal. 291. Roy. lugdh. 263.
Cucurbita major rotunda, flore luteo, folio asperso. Bauh. pin. 213.
Cucurbita indica rotunda. Dalech. Hist. 616.

A free translation of the above, including the synonyms on which the species is based, would be "a cucurbit with lobed, rough leaves, yellow flowers, large, round, smooth fruits, and seeds with swollen margins." The species may be further characterized as follows:

The leaves are decidedly lobed and often deeply cut, the number of lobes being 3, 5, or 7. In many of the varieties the hairs on the petioles and lower surfaces of the leaves become very stiff and sharp. The calyx lobes are rather fleshy and subulate, never foliaceous. The corolla is very similar to that of *C. maxima*, except that it is rather less spreading. The fruiting peduncle is 5-ribbed, and never more than slightly enlarged at its point of attachment to the fruit.

Duchesne's original description[8] of *C. moschata* may be summarized as follows:

This species, very difficult to circumscribe, is made up of several varieties which have been too little observed to determine well. The plant is first mentioned by Chanvalon in his *Voyage de la Martinique*. Lamarck does not find sufficient differences to separate it as a distinct species. However, two differences may be noted, the contraction of the base of the calyx, and the close smooth down of the leaves. It resembles the calabash (*Lagenaria vulgaris*) in the whiteness of the flowers, the elongation of the green tips of the calyx, and the musky flavor of the fruit. The leaves resemble those of the gourds; they are angular or sharp lobed. The fruit is most often flattened; sometimes it is cylindrical, club-shaped or pestle-shaped; the color of the pulp varies from sulfur yellow to orange red. The fruit is cultivated like the calabash. In spite of its common name "musk melon," it furnishes only a mediocre fruit, rarely eaten raw; however, it is somewhat esteemed in the southern parts of France, in Italy, and in the islands of America. The fineness of its flesh and its good flavor make it preferred to most pumpkins.

The above description may be amplified by stating that the leaves are generally dark green and mottled with white at the angles of the principal venations. The calyx tube is much reduced, sometimes almost want-

[7] Sp. Pl. 1010. 1753.
[8] Dict. Sci. Nat. 11: 234. 1818.

ing, and the sepals, instead of being subulate or filiform, are broader and very often leaflike. The fruiting peduncle is 5-angled and considerably swollen where it is attached to the fruit; it is less sharply angled than the peduncle of *C. pepo*.

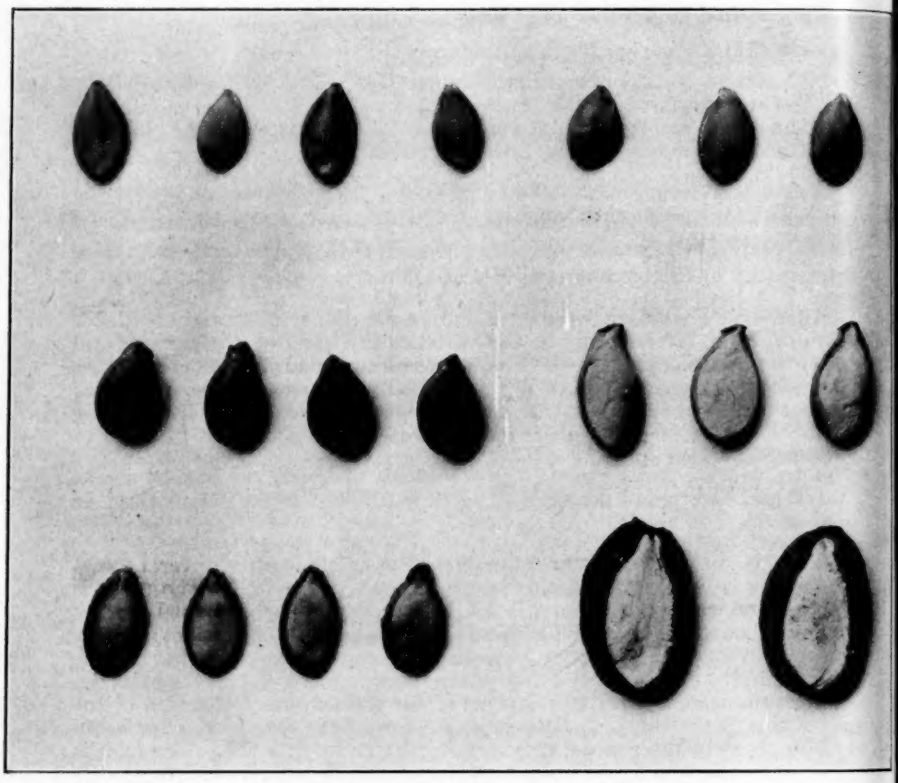

Fig. 1 Seeds of the commonly cultivated species of *Cucurbita*

Top row, Pie pumpkin (variety of *C. pepo*); middle row, two varieties of *C. maxima;* bottom row, two varieties of *C. moschata*.

As a result of the discovery of apparently constant specific characters in the seeds of the cultivated species of *Cucurbita*, it has been possible to name correctly over a hundred seed samples in the seed collection of the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry. The following key should also prove valuable as a check on the identity and, to some extent at least, on the purity of commercial seed samples of varieties included in these three species.

KEY TO THE SEEDS OF THE ANNUAL SPECIES OF CUCURBITA

Scar obliquely truncate; face of seed pure white or clear brown ..*C. maxima.*
Scar normally squarely truncate or rounded; face of seed ashy gray or dirty white
Margin agreeing in color with face of seed, usually smooth and not swollen.....*C. pepo.*
Margin darker than face of seed, rarely smooth, often swollen and corky, or roughened and stringy.....*C. moschata.*

The characters upon which this key is based are shown in the accompanying illustration (Fig. 1). The top row of seeds are of the Pie pumpkin, a good example of *C. pepo.* The middle row shows two varieties of *C. maxima;* the one at the left is the Ironbark pumpkin, from South Africa; the one at the right is the well-known Hubbard squash. Both of these show the oblique scar characteristic to *C. maxima.* The bottom row shows two varieties of *C. moschata;* the one at the left is the Faan Kwa squash, from China; the one at the right is Charles Naudin, from France.

In some cases it has been observed that immature seeds do not show the distinguishing characters, so that, for identification purposes, it is advisable to have mature seeds, and also to have several of a kind, in order to allow for unusual variations.

BOTANY.—*The genus* Forchammeria.[1] PAUL C. STANDLEY, U. S. National Museum.

In the course of work upon the Trees and Shrubs of Mexico, now in course of publication as volume 23 of the Contributions from the National Herbarium, the writer happened upon material of two Mexican plants belonging to distinct species but evidently congeneric, which it was impossible to refer even to a family, since they bore little general resemblance, apparently, to anything reported from Mexico. Recently, however, while examining a collection of plants obtained by O. F. Cook in Petén, Guatemala, there was discovered a fruiting specimen of a plant which was undoubtedly a relative of the Mexican ones, and their systematic position was recognized.

The Guatemalan plant was *Forchammeria trifoliata,* a species described from Yucatán, and based upon flowering material alone. The fruit had not been known previously, and proved to be so dissimilar from that of two common Mexican species of the genus that the close relationship existing between these three plants would not be apparent if their fruits were placed side by side. Study of the copious material of *Forchammeria* in the National Herbarium indicates that the species fall into two sharply marked groups, which may be

[1] Published by permission of the Secretary of the Smithsonian Institution.

treated as subgenera. The characters which distinguish them are indicated below in the key to species.

The difference in development of the ovary in these two groups results in fruits of two types so distinct that it might be advisable to treat *Helandra* as a generic unit; but on the other hand, the fruits are essentially the same in structure, and their final differences are due only to different modes of development. In *F. longifolia* I have seen a single fruit in which both cells developed equally, so that the seeds were vertical, and the stigma apical in a depression between the two cells, but such a condition was evidently abnormal, only one such fruit having been found among a hundred or more.

The form of the fruit in the subgenus *Helandra* is suggestive of that of the soapberry, *Sapindus saponaria*. The resemblance is so striking that at first it was believed that fruiting specimens of *Forchammeria longifolia* must belong to the family Sapindaceae.

Although placed by Bentham and Hooker in the Euphorbiaceae, *Forchammeria* is now referred to the Capparidaceae, where, however, it has no close relatives. It has had an interesting history, most of the few species having been described at long intervals. The genus is restricted, so far as now known, to Mexico, Guatemala, Salvador, and Hispaniola.

KEY TO SPECIES

Ovary 2-celled, one of the cells obsolete in fruit, not apparent externally, the fruit obovoid, the stigma remaining apical; seed vertical; staminate and pistillate inflorescences racemose; leaves simple. Subgenus **Euforchammeria.**

Leaves glabrous, oblanceolate or oblong.....**1. F. pallida.**

Leaves hirtellous, especially beneath, linear.

Leaf blades emarginate at base; fruiting pedicels 3–5 mm. long; fruit 7–12 mm. broad.....**2. F. watsoni.**

Leaf blades usually attenuate at base; fruiting pedicels 10–15 mm. long; fruit 12–15 mm. broad.....**3. F. macrocarpa.**

Ovary 2-celled, only one cell developing in fruit, the other, however, slightly accrescent and forming a rounded protuberance at the base of the fruit, the latter subglobose, the stigma borne at the apex of the sterile cell and thus lateral; seed horizontal; staminate and pistillate inflorescences usually racemose-paniculate; leaves compound or simple. Subgenus **Helandra** (type species, *Forchammeria trifoliata* Radlk.).

Leaves compound, 1–3-foliolate, if unifoliolate the petiole jointed with the blade.

Leaflets narrowly oblanceolate-oblong, more than three times as long as wide; fruit 7–8 mm. in diameter.....**4. F. longifolia.**

Leaflets obovate or obovate-elliptic, scarcely over twice as long as wide; fruit 10–12 mm. in diameter.

Leaves 3-foliolate; staminate inflorescence much branched.

5. F. trifoliata.

Leaves mostly 1-foliolate, rarely 2 or 3-foliolate; staminate inflorescence nearly simple.....**6. F. sphaerocarpa.**

Leaves simple.

Leaves sessile or nearly so, the blades rounded or cordate at base **7. F. sessilifolia.**

Leaves petiolate, the blades attenuate at base.....**8. F. brevipes.**

1. **Forchammeria pallida** Liebm. Nat. For. Kjöbenhavn Vid. Medd. **1853:** 94. 1854.

Forchammeria apiocarpa Radlk. Meth. Bot. Syst. 54. 1883.

Western coast of Mexico, from Colima to Oaxaca. The type species of the genus.

2. **Forchammeria watsoni** Rose, Contr. U. S. Nat. Herb. **1:** 302. 1895.

Baja California, Sonora, and Sinaloa. Known in Baja California as *palo San Juan.*

3. **Forchammeria macrocarpa** Standl. Contr. U. S. Nat. Herb. **20:** 183. 1919.

Forchammeria purpusii Loesener, Repert. Sp. Nov. Fedde **16:** 204. 1919.

San Luis Tultitlanapa, Puebla. Both names are based upon the same collection.

4. **Forchammeria longifolia** Standl., sp. nov.

Shrub, about 2 m. high, with few stems, glabrous throughout; leaves partly unifoliolate and partly trifoliolate, the petioles of the former 1–2.5 cm. long, of the latter 2–3.5 cm. long; leaflets narrowly oblanceolate-oblong, 12–22 cm. long, 3–6.5 cm. wide, obtuse or acute, gradually attenuate to the cuneate base, coriaceous, the venation inconspicuous on the upper surface but slightly elevated beneath, the lateral nerves about 16 pairs; pistillate inflorescences clustered on old wood, racemose-paniculate, many-flowered, 10–15 cm. long; fruiting pedicels 3–8 mm. long; fruit yellow, subglobose, 7–8 mm. in diameter, smooth, sessile or nearly so, bearing at base a small rounded protuberance, the abortive second cell of the ovary; seed compressed-globose, 6–7 mm. in diameter.

Type in the U. S. National Herbarium, no. 568024, collected in woods, Pueblo Nuevo, Veracruz, near Tampico, Mexico, May, 1910, by Edward Palmer (no. 444). A second specimen of the same collection is mounted upon sheet no. 568025.

The leaves borne at the tips of the branches are trifoliolate, but the lower ones are unifoliolate. *Forchammeria longifolia* is evidently related to *F. trifoliata*, but is distinguished by the presence of numerous unifoliolate leaves, the long narrow leaflets, and the smaller fruit.

5. **Forchammeria trifoliata** Radlk. Field Mus. Bot. **1:** 399. 1898.

YUCATÁN: Izamal, *Gaumer* 417 (type collection).

GUATEMALA: Naranjo, *Cook & Martin* 65.

SALVADOR: Ahuachapán, *Standley* 20273.

In both Yucatán and Guatemala the tree is known as *Tres Marías.* The Salvadorean specimen, taken from a sterile shrub of 2 meters, differs slightly in the shape of its leaflets, but is probably conspecific.

6. **Forchammeria sphaerocarpa** Urban, Symb. Ant. **1:** 310. 1899.

Type from Jérémié, Haiti, *Picarda* 1308. Not seen by the present writer, but from the description evidently referable to the subgenus *Helandra.*

7. Forchammeria sessilifolia Standl., sp. nov.

Tree, 6–12 m. high, glabrous throughout; leaves sessile or nearly so, the blades oblong, sometimes slightly broadest above the middle, 14–19 cm. long, 4–9 cm. wide, obtuse or acutish at apex, cordate or rounded at base, coriaceous, the venation prominulous on both surfaces, the lateral nerves about 11 pairs; staminate flowers in lax, once or twice branched, many-flowered panicles borne on old wood, the panicles pedunculate, 10–20 cm. long or larger, the flowers partly sessile, but often on pedicels 3–7 mm. long; stamens 15–20, the filaments about 3 mm. long, the anthers subglobose.

Type in the U. S. National Herbarium, no. 908024, collected on María Madre Island, Mexico, May, 1897, by E. W. Nelson (no. 4239). A second specimen of this collection is mounted upon sheet no. 569214.

This species is well marked by its sessile leaves with broad bases. Although only the staminate plant is known, the general appearance indicates that it is of this alliance rather than a species of *Euforchammeria*.

8. Forchammeria brevipes Urban, Symb. Ant. **7**: 225. 1912.

Type collected in the Province of Barahona, Dominican Republic, at an elevation of 1300 meters, *Fuertes* 544.

A specimen of the type collection is in the National Herbarium, but it is in poor condition, although there is no doubt of its relationship. This is the only species of the subgenus *Helandra* in which the staminate inflorescences are not known to be paniculate, but those of the type material are so imperfect that one can not be certain as to their character.

EXCLUDED SPECIES

FORCHAMMERIA LANCEOLATA Standl. Contr. U. S. Nat. Herb. **20**: 183. 1919. Further study shows that this is *Drypetes crocea* Poit., of the Euphorbiaceae, a genus not reported previously from Mexico. The former name was based upon *Pringle* 3728, the locality of which was not known at the time the description was published. It is now known to have been collected in Tamasopo Canyon, San Luis Potosí.

SCIENTIFIC NOTES AND NEWS

The annual excursion of the Petrologists' Club was held on May 3. The party left Washington on the preceding evening by the Southern Railway and were met at Shipman, Virginia, by Prof. T. L. Watson, State Geologist of Virginia, who acted as guide. A trip was first made by autobus to the workings of the American Rutile Company near Roseland in Nelson County. This locality is on the eastern border of an area of syenite near its contact with the biotite-quartz monzonite gneiss which is the prevailing rock of this part of the country. Gabbro is also present along this border intergrading with the syenite. The titanium minerals rutile (TiO_2) and ilmenite ($FeO.TiO_2$) occur in these bordering rocks. They are extracted by crushing, washing, and magnetic separation. This locality is the principal source of rutile in the United States.

Two interesting features of the locality were Triassic diabase dikes cutting but not appreciably metamorphosing the rutile-bearing syenite; and dikes of nelsonite, an unusual rock consisting of apatite with rutile or ilmenite.

Returning to Shipman, the party proceeded north a few miles by the Southern Railway to Rockfish, where they were taken by a car of the Virginia Alberene Company by way of the branch railway to Schuyler, Virginia. Here the large quarries of the Alberene Company were visited. They are the source of practically all the soapstone used for laundry tubs, heaters, laboratory tables, etc. The rock is taken out in blocks by means of channeling machines and is then sawed into slabs, trimmed, polished, and assembled into commercial forms.

RALPH EDWARD GIBSON, a graduate of the University of Edinburgh, has joined the staff of the Geophysical Laboratory as physical chemist.

NEIL M. JUDD, Curator of American Archeology, National Museum, left Washington on May 16 to resume direction of the explorations of the National Geographic Society at Pueblo Bonito. This prehistoric ruin, one of the largest and most important in the southwestern United States, is the most famous unit of the Chaco Canyon National Monument. The society began its explorations in Pueblo Bonito in 1921; it is hoped that the work will be concluded by the end of 1925.